their works as doomed to rapid extinction. Whether an examiner should prepare a text-book for his own syllabus is a matter of opinion, and much can be said both for and against the system. But, however that may be, it is certain that persons desirous of passing an examination could not do better than read the works of the one who sets the questions. In the case of the book before us, we have no hesitation in saying that it is as clear and connected an exposition of the laws of health and causes of disease as anyone could desire, be he a sordid hunter after certificates or a true seeker after knowledge. The authors have treated their subject scientifically, and yet with few technicalities, hence their work should appeal to a large public. Beginning with a chapter on air, they pass to others on water and food, and then to soils, sites, and buildings. The fifth chapter is concerned with drainage, after which are treated personal hygiene, infection and disinfection, parasites, climate and weather, and finally vital statistics. It will be seen from this that the subject is not treated in all its bearings; nevertheless, what is included in the manual forms an excellent basis for further study. Students who use the book will find it a pleasant road to knowledge, and they may confidently put their trust in its contents.

We note that here and there the authors, like many other writers on hygiene, do not sufficiently distinguish between heat and temperature. For instance, on p. 283 it is written: "At the ordinary temperature of the air, water boils at 212° F., and the moment the temperature falls below that heat, steam condenses." In this sentence the word heat is used in the sense that a cook employs it, not as a scientific man should write it.

Dr. Reynolds' primer deals with those portions of hygiene which concern the health of the household. If its contents were more widely known, the mortality from preventible disease would be greatly diminished. The greatest praise that can be given to a primer is to say that readers of the book will acquire just the kind and amount of knowledge to make them, like Oliver Twist, hunger for more. This commendation can safely be given to Dr. Reynolds' little volume, which is a model of what an introduction to hygiene, suitable for the general reader as well as the elementary student, should be.

Fur and Feather Series.—The Grouse. By Rev. H. A. Macpherson, A. J. Stuart-Wortley, and George Saintsbury. Edited by Alfred E. T. Watson. (London: Longmans, Green, and Co., 1894.)

IN the book before us the grouse is regarded from three different standpoints, and treated accordingly. In the first, the Rev. H. A. Macpherson introduces us to his natural history from the point of view of sport, telling us, after he has devoted a chapter in praise of the bird, the manners and "private life" of the grouse; the enemies with which it has to deal; the variability of the plumage in which it is wrapped, and the methods by which grouse are captured by "becking." These chapters are full of anecdotes and thoroughly readable, and they make one long to hear the cocks uttering their clear ringing "Er—eck—kek—kek! wuk, wuk wuk."

The second part is devoted to the shooting of the bird, and is contributed by Mr. A. J. Stuart-Wortley, who handles the subject in a straightforward manner.

We might here discuss at length the contents of the seven chapters on this subject, but we will leave it to the reader to find out for himself what the author has to say on such subjects as Scotch and English driving, ground stock and poaching, records and remarks, shooting over dogs, &c.

The third and concluding section of the book deals with the last, but by no means the least important, stage of the grouse—his presence on the dinner table. Mr. George Saintsbury completes his task well in laying before the reader the numerous and widely different methods of cooking. Not only is the treatment applied to the bird as a whole, but also to such variations as grouse soup, *quenelles, croquettes, bouchées*, &c.

Summing up then in a few words, we may say that we have nothing but praise to bestow on the book, which is a very valuable contribution to natural history, and worthily keeps up the reputation of the admirable series of which it forms a part. Every naturalist and every carrier of the gun will find it delightful to read, and at the same time will, no doubt, receive many useful wrinkles. Besides the text being all that could be desired, the illustrations are really excellent. They are after the drawings of Mr. A. J. Stuart-Wortley and Mr. A. Thorburn, and were designed under the supervision of the first named.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Has the Case for Direct Organic Adaptation been fully stated?

THE heading of this letter is in the form of a question for the following reasons: (1) It is impossible to keep pace with the literature on the subject of Evolution while engaged on any other absorbing work; and (2) so many giants have been engaged in the discussion, that it requires courage even to suggest that a point has been overlooked. It seems to me that nothing could be added to Herbert Spencer's convincing arguments that acquired characters must somehow be transmitted. I wish merely to suggest a method of describing this transmission which I have never yet seen in print, and which, I must think, is not generally recognised, inasmuch as it modifies Weismann's "contradictory facts" into not insuperable difficulties.

While studying the Phyllopod Crustacean Apus, I came to the conclusion that it might be derived from an Annelid which bent its head segments round ventrally, and pushed the food into its mouth with its parapodia. Simple as the suggestion may seem, the facts are indisputable that Apus *can* be so deduced, and further, that there is a considerable mass of evidence to show that it actually was so deduced.[1] If so, we should have one group of animals, the Crustacea, developed from another, the Annelida, not primarily by the summation of a long series of small variations by the action of Natural Selection, but by the active adoption on the part of a portion of the latter of a special manner of feeding. We may perhaps briefly describe the process as follows. A certain number of Chætopod Annelids found themselves in a region where the most favourable diet was only to be obtained in the manner described; the mouth had to be turned down ventrally so as to open backwards, and the lateral parapodia (bordering it in its new position) raked the food together and pushed it into the mouth. Generations of these Annelids would be produced in the same region, and would, in response to the same stimulus, practise the same method of feeding. Natural Selection would perfect the habit, and also *inevitably perfect it earlier and earlier in the lives of succeeding generations.*

But here, it will be said, we have ultimately to call in the aid of the transmission of acquired characters by inheritance. Yes; but this inheritance comes in at the end of a long series without appreciable break in the regular sequence. The last stage of individual acquirement is when the very youngest animal capable of feeding adopts the perfected habit as it first feeding act—in response, that is, to the same stimulus from the environment which led its parents to adopt it. The very next stage is that in which the young animal places its head segments in the right position prior to being able to feed. Here we may assume either that the "instinct" has been inherited, or, considering that the possible positions of the head segments are not numerous, that Natural Selection winnowed out all those

---

[1] I have endeavoured to accumulate this evidence in the following publications:—"The Apodidæ," NATURE Series, 1892, and "The Systematic Position of the Trilobites," in the *Quarterly Journal of the Geological Society*, August 1894.

© 1894 Nature Publishing Group

whose heads were not ready. I prefer the former hypothesis, for it is not, in this case, the inheritance of characters casually acquired by a few chance individuals, but of characters which have been regularly acquired by the race for several generations as an active organic adaptation to the environment.

It is needless here to multiply illustrations, but this and kindred cases have led me to ask whether too much attention has not been paid to single organisms and the modifications of chance individuals, whereas if a whole colony of similar organisms invade a new region, all have to adopt new habits of life; the young members of the colony and the new young continually born, being plastic, will, before they are adults, show marked structural modifications in adaptation to these new habits. They are actively modified by these functional adaptations to their environment. Natural Selection will winnow out those who do not keep in training, and at the same time infallibly compel the successive generations to perfect themselves earlier and earlier. We should thus have stages (but without appreciable breaks in the sequence) in this evolutionary process. (1) The young are born and continue for some time like the ancestors of the group, while the adults show considerable structural modification; (2) the new-born young resemble the ancestors of the group, but commence early to show the functional adaptations of the adults; (3) the new-born differ slightly from the ancestors of the group, inheriting (or possessing "accidentally") slight modifications in the right direction which enable them still earlier to perfect the necessary adaptation; (4) the young are born with the structures necessary to the immediate adoption of the habits required by the environment.

It seems to me that, in this way, we actually have the transmission of acquired characters by inheritance, this inheritance coming in as a natural term at the end of a long series of individual acquirements. The prime factor in the evolution of new forms is, therefore, the vital response to the environment of living colonies of exquisitely sensitive organisms; Natural Selection not only perfects, but drives the resulting modifications back earlier and earlier in the life-history of each individual of the colony *until they are inherited*.

This principle, it seems to me, explains the degeneration of structures which are "only passively functional," such as a hard shell. If the environment no longer requires a shell, it will not be maintained. It is inherited, say, from ancestors, but each fresh generation, or in the case of the Crustacea, each moult, gives a new start. If the shell owed its origin to the inorganic environment, it would cease to be developed when the special stimulus to its production were withdrawn, for the skin which secretes the shell is passively functional only so far as the organism is concerned; as a living tissue it is actively responsive to its environment. Or again, the shell owed its origin to the protection it afforded from enemies, and thus partly to the survival of those which accidentally had slightly thicker skins; but partly, and I think chiefly, also to the powers of the skin as a complex tissue to resist the attacks of the many small enemies, such as animal and vegetable parasites, which are a constant element in almost all environments. In this case, also, with each generation or moult we have a fresh start; on the removal of the constant irritation from these enemies, the energies of the animal would be otherwise employed than in re-developing its shell.

In order to account for the progressive or retrogressive modifications in the sterile workers of Hymenopterous colonies, we have in the same way to assume the functional modification of the plastic young as the prime factor; Natural Selection not only perfects these modifications, but *drives them back earlier and earlier in the life histories of the individuals*. We can thus understand that a stage might be reached when the difference of the food administered to the larva might modify its course of development. The structural modifications of the workers in this case are not inherited, but they are also not primarily due to Natural Selection, but to the response of organisms *in ever-recurring plastic series* to the requirements of their environment.

Again, the ceaseless efforts of the young individuals of a colony to adapt themselves to a new environment can alone, it seems to me, account for the possible utilisation of congenital variations, which are useless in themselves without concomitant variations. These latter will be acquired by the efforts of the organism, so far, that is, as to render the former functionally useful.

On the other hand, the "time" difficulty in evolution admits of easy solution if it can be shown that groups of organisms actively respond to changes of environment, as plants adapt themselves to a new surface by the plasticity of their growing shoots. Further, the difficulty that organisms are known to have remained practically unchanged through immense geological periods, is explained by the supposition that their environment must have also remained practically unchanged.

For the solution of many of the difficulties in evolution, we have then to look to the functional response of *colonies* of organisms, and of the living parts of such organisms to their respective environments. This power of adjustment accounts not only for the formation, but also for the maintenance of species. The force of Heredity has been overstated, while the power of immediate vital response of delicately balanced organisms to every slight change in the environment has been very much understated. If we keep in view the ever-recurring generations of plastic young, the direct stimulus of the environment is seen almost necessarily to be a force of prime importance perpetually overmastering the somewhat exaggerated rigidity of species attributed to heredity. There is no such thing as rigidity; everything is rather in a state of flux. Is this unending variation, always in adjustment to the environment, due to Natural Selection taking advantage of the occasional accidental slips in an otherwise rigid heredity? or, is it due to the direct response of organisms in a state of finely balanced equilibrium? This latter seems to me the more probable, the resulting structural modifications being, on the one hand, hindered by Heredity; on the other, if the conditions require it, hastened and perfected by Natural Selection. This hastening action of Natural Selection leads inevitably to inheritance.

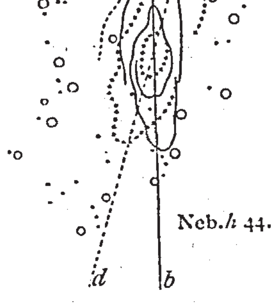
The evolutionary theories known as Lamarckism and Darwinism, only break down when they are supposed to be mutually exclusive. Is it not possible to unite them somewhat in the manner here suggested? H. M. Bernard.

Natural History Museum, September 17.

The Great Nebula in Andromeda.

In reference to Dr. A. A. Common's review of Dr. Roberts' beautiful collection of celestial photographs (Nature, No. 1297, September 6), where he says "There is a fair presumption that in course of time the rotation of the outer portion (of the great Andromeda nebula) may perhaps be detected by observation of the positions of the two outer detached portions in relation to the neighbouring stars," I wish to point out that changes of this kind will perhaps be detected much sooner than it is generally expected.

In the accompanying drawing (presented May 2, 1894, to the *Société Astronomique de France*), *a-b* indicates the outline of



the small elongated nebula *h* 44, as it was seen by Trouvelot at Cambridge (Mass.) in 1874; *c-d* the limits of the nebulosity

© 1894 Nature Publishing Group